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Rev. 0

Sampling and Analysis Plan for the REDOX Plutonium Loadout Hood

United States
Department of Energy
Richland, Washington

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHI	CH2M HILL Hanford, Inc.
COC	contaminants of concern
COPC	contaminants of potential concern
CVAA	cold vapor atomic absorption
D&D	decontamination and decommissioning
DQO	data quality objectives
Ecology	U.S. Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
FSP	field sampling plan
GEA	gamma energy analysis
H&S	Health and Safety
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
ICP	inductively coupled plasma
NDA	nondestructive assay
PR	product recovery
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	reduction oxidation
RL	U.S. Department of Energy, Richland Operations Office
SAF/FSR	Sampling Authorization Form/Field Sampling Requirements
SAP	sampling and analysis plan
TCLP	toxicity characteristic leachate procedure
TRU	transuranic
TRUSAF	Transuranic Waste Storage and Assay Facility
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

This sampling and analysis plan (SAP) presents the rationale and strategy for the sampling and analysis activities proposed in support of decontaminating and removing the Plutonium Loadout Hood from the Reduction Oxidation (REDOX) process canyon building. The results of this investigation will be used to estimate the types of radiological and chemical contaminants and for initial waste designations for the component vessels, pipes, loadout hood frame and plexiglass, decontamination materials, and debris, as well as for development of future safety analysis documentation for eventual removal of the Plutonium Loadout Hood.

This section provides background information about the project, as well as a discussion of the previous investigations performed at the site, a list of the contaminants of potential concern (COPCs), and a summary of the data quality objectives (DQOs).

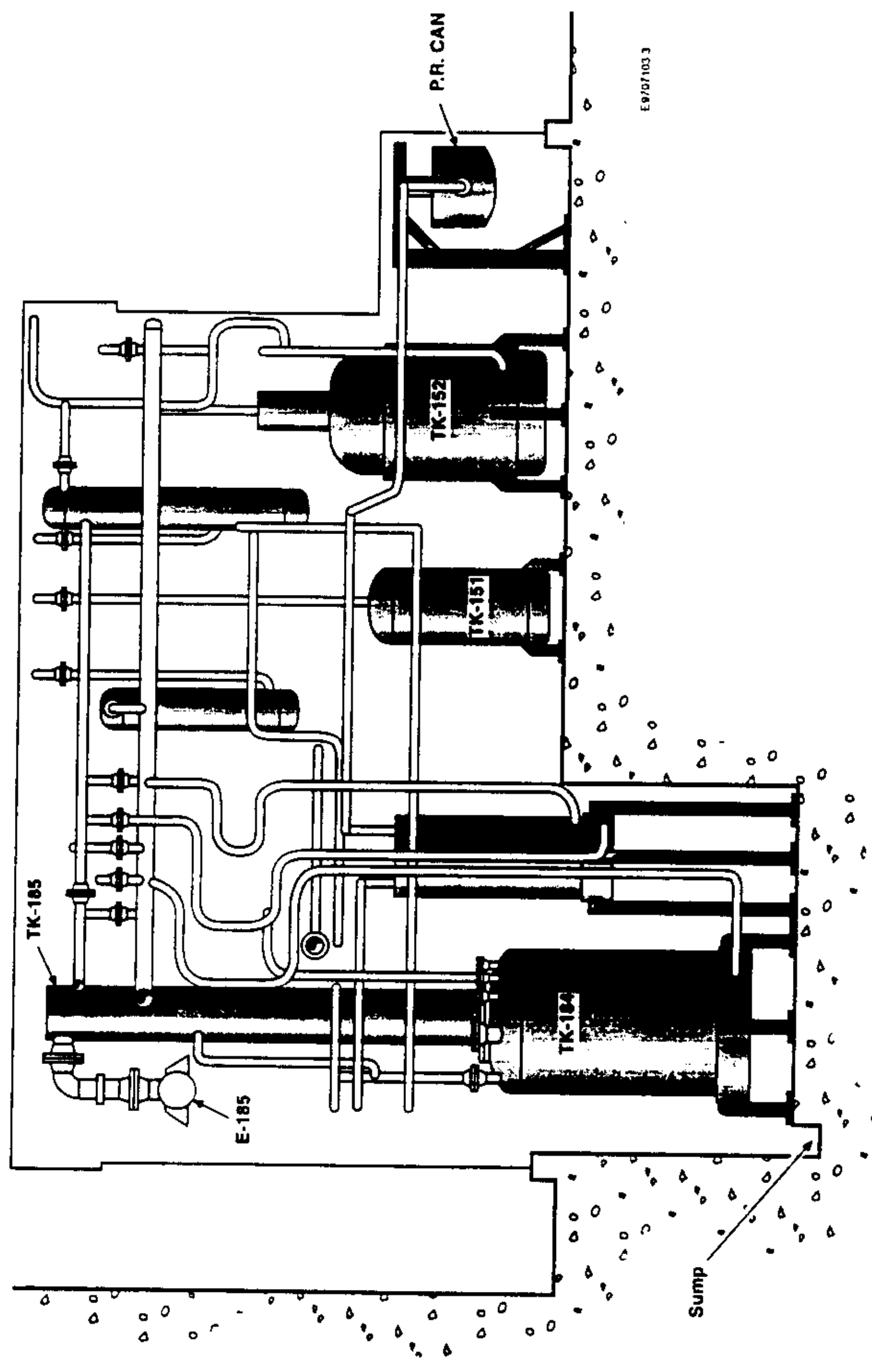
1.1 Background

The Hanford Site became a Federal facility in 1943 when the U.S. Government took possession of the land to produce nuclear materials for defense purposes. The Hanford Site's production mission continued until the late 1980's, when the mission changed from producing nuclear materials to cleaning up the radioactive and hazardous/dangerous wastes generated over the previous years.

The REDOX separations process was implemented at the 202-S Canyon building in January 1951 and was discontinued at the end of 1966. The REDOX process used several organic solvent extraction steps that allowed continuous separation of both plutonium and uranium from dissolved fuel rod solutions. Following separations and decontamination steps, the Plutonium Loadout Hood vessels received plutonium-rich solutions and concentrated batch sizes from 231 to 30 L (61 to 8 gal) in two steps. The plant was modified in 1954-1955 to improve operational performance, at which time the Plutonium Loadout Hood was taken out of service and replaced with the 233-S facility. Several pipes exiting the west side of the loadout hood connect the canyon process cells to 233-S.

The Plutonium Loadout Hood (Figure 1-1) is composed of a metal frame supporting a series of 0.97-cm- (3/8-in.) thick plexiglass panels. This enclosure isolates a number of process vessels and piping used in the final plutonium concentration step. The plexiglass part of the hood is approximately 2.55 m (8 ft 6 in.) high and sits on a raised concrete curb 15.2 cm (6 in.) high. The topmost 0.6 m (2 ft) of the hood is enclosed by stainless steel panels. The hood is configured in an "L"shape with the base leg 3.4 m (11 ft) long and 1.5 m (5 ft) wide and the other leg 5.2 m (17 ft) long and 1.5 m (5 ft) wide. Originally, this section of the hood was 6.4 m (21 ft) long, but a section of frame and paneling was removed, along with the plutonium removal (PR) can, after the end of loadout hood operations.

Figure 1-1. Plutonium Loadout Hood.



The floor of the hood area was built at two different levels to accommodate several large process vessels. On the base end of the "L", the floor is depressed 1.35 m (4 ft 6 in.) deeper than the floor level in the North Sample Gallery and forms what is called the pit. The 216-E-16 Pre-Concentrator and 216-E-17 Concentrator are located in this depression. A 15.2-cm (6-in.) cubical sump, equipped with a vacuum transfer jet, is located at the northwest corner of this depression. The sump also receives drain overflow from the 233-S Process Hood.

Based on Hanford drawing H-2-008239, all concrete floors and walls (including the pit and sump) were covered with 16-gauge stainless steel sheets that were welded together and to the Unistrut framing or framing support flats set into the concrete curbing. However, based on visual observations and reports, the stainless steel sheeting is no longer present. Stainless steel panels are also used in the topmost frame panels where the plant's ventilation system is tied-in to the hood. Stainless steel panels are used for panel locations next to existing building walls.

Holes were cut into the top stainless steel panels for utility pipe access to the hood. Much of the pipe has been removed, and the holes are covered with duct tape. At least ten holes were cut into plexiglass panels for valve stem extensions used to control flow into or out of the process vessels or to control heating and cooling of liquids in the concentrators. Most of these valve stem extensions exited through flanged connections inserted into the plexiglass. In addition, recently added piping reroutes penetrate the west hood wall panels at several locations. The penetrations are routed through sealed flanges. Individual hood panels are removable and are equipped with handles and several types of clamps to ensure good isolation. Duct tape has been added to improve panel seam seals. Air filters were built into several plexiglass panels to allow removal of airborne contaminants pulled in from the North Sample Gallery atmosphere. Air was discharged into the plant ventilation system through ductwork at the top of the Plutonium Loadout Hood. A lighting system was not installed inside the Plutonium Loadout Hood.

Nine major vessels are located inside the hood and were used to concentrate plutonium nitrate solutions. The vessels are described in Table 1-1. None were configured for criticality control, because, during this step of the process, more than 300 g of plutonium was not expected to be received in any one batch. A number of pipes connect the vessels or provide access from utility services such as the steam, vacuum transfer, or cooling water systems.

1.1.1 Process Flow Steps

Dilute plutonium nitrate was collected in the E-3 sampler holding tank after completing the third cycle plutonium extraction (decontamination) process step in the E cell. This solution was then jetted to the E-16 Pre-Concentrator vessel inside the hood in 231-L (61-gal) batches. The pre-concentrator vessel consists of a lower large pot unit with both steam coils and a steam sparger, and an upper tower (or column) unit filled with Raschig rings. Nitrate solutions were boiled in the pot, and vapors rose through the tower unit where water and volatile chemical vapors were separated and drawn off. The Raschig rings are supported on racks in the column and increased the efficiency of volatile separation. Rising vapors were drawn off at the top of the tower carrying water vapor and residual (~1.6%) hexone. The vapors were condensed in the E-15

Table 1-1. Plutonium Loadout Hood Process Vessels.

Vessel Designation	Vessel Use	Vessel Dimensions
E-14, Pre-Concentrator Condenser Receiver Tank	Receives condensate from E-15 Condenser	0.6 m 15.2 cm dia x 0.9 m 15.2 cm (2'6" dia. x 3'6")
E-15, Pre-Concentrator Condenser	Condense E-16 vapors	20.3 cm dia. x 1.5 m 20.3 cm (8" dia. x 5'8" long)
E-16, Pre Concentrator	Concentrate plutonium nitrate	Pot: 0.9 m dia. x 1.5 m high (3' dia. x 5' high) Column: 30.5 cm dia. x 2.4 m 15.2 cm high (12" dia. x 8' 6" high)
E-17. Concentrator	Concentrate plutonium nitrate	Pot: 53.3 cm dia. x 1.2 m high (21" dia. x 4 ft high) Column: 15.2 cm dia. x 1.8 m 17.8 cm high (6 " dia. x 6' 7" high)
E-18, Plutonium Concentrator Condenser	Condense E-17 vapors	20.3 cm dia. x 1.2 m 5 cm long (8" dia. x 4'2" long)
E-19, Concentrator Condensate Receiver Tank	Collect E-18 condensate	0.3 m 15.2 cm dia. x 0.9 m high (1'6" dia. x 3'0" high)
E-20, Transfer Trap Vacuum Jet Condenser	Condense vacuum transfer vapors	20.3 cm dia. x 1.2 m 5 cm long (8" dia. x 4'2" long)
E-21, Plutonium Transfer Trap	Collect vacuum transfer liquids	0.6 m 15.2 cm dia. x 0.9 m 15.2 cm high (2'6' dia. x 3'6" high)

Condenser and liquid collected in the E-14 Condensate Receiver Tank for waste treatment and disposal or recycling back into the process for additional refining. After boiling, the solution was cooled in preparation for transfer. This step concentrated the solution to an 87-L (23-gal) batch.

The partially concentrated plutonium nitrate solution was then transferred to the E-17 Concentrator, which is a downsized design of the E-16 Pre-Concentrator. Again, steam was used in the pot section of the vessel to boil off water. The vaporized solution moved through the Raschig ring-filled tower section, and water vapor was drawn off at the top. Vapors were condensed in the E-18 Condenser and the liquid collected in the E-19 Condenser Receiver Vessel. This step reduced the total volume of solution from 87 L (23 gal) to approximately 30 L (8 gal). After this point, the concentrate was transferred into a PR can and taken to the 234-5 Building for further processing.

The E-20 vessel collected condensate generated during vacuum transferring of solutions between tanks. The E-21 vessel was used to store the vacuum condensate transferred past the PR can and could be used to reroute process material back for plutonium concentration steps.

In 1953-1954, upgrades to the REDOX process and plant were implemented. These upgrades included design and construction of the 233-S Plutonium Concentration Facility, which replaced the Plutonium Loadout Hood. It is reported that the process hood room drain at 233-S was rerouted back into the Plutonium Loadout Hood and into the pit sump.

No reports have been found that document cleanout of the hood vessels after startup of 233-S, but it is expected that acid washes followed by rinses were performed until the level of contamination in the streams did not change. The REDOX plant remained active until December 1966, at which time a cleanout campaign was initiated prior to plant shutdown. Multiple acid (nitric, sulfuric, oxalic) and chemical (sodium dichromate) washes followed by water rinses were used throughout REDOX piping to remove residual plutonium.

Reports of americium/curium and neptunium process runs during the last stages of REDOX plant operations are known, and it has been suggested that the Plutonium Loadout Hood vessels were involved. Reportedly, the process was conducted in the headend tanks of H Cell, and the radionuclides were removed from the building in "bowling ball" casks. This description does not suggest that the Plutonium Loadout Hood was used in the special process runs. Several neptunium runs during routine plant operations are known during which the Plutonium Loadout Hood vessels may have been used.

1.1.2 Previous Investigations

The previous and current site contractors have performed routine surveillance and maintenance (S&M) inspections at the REDOX canyon building since the start of operations. Since the start of the Environmental Restoration Contract (ERC) program, Bechtel Hanford, Inc. (BHI) has conducted the most recent radiological surveys. Representative ERC radiological survey records are found in report I-200-511, dated August 24, 1995; PS-202S-001/002, dated October 23, 1995; PS-202S-0118, dated March 12, 1996; PS–202S-0164, dated April 9, 1996; PS-202S-0748, dated October 7, 1996; and PS-202S-0832, dated October 25, 1996. For example, the October 23, 1995 survey indicates smearable contamination on the floor outside the loadout hood that ranged from <20 to 3,500 disintegrations per minute (dpm) alpha and <1,000 to 10,000 dpm beta/gamma. The loadout hood is posted as a Radiation Area. During the March 12, 1996 survey, the area around the outside of the hood and one of the sample ports directly behind the hood were more thoroughly investigated. Smearable contamination on the hood walls ranged from <20 to 1,400 dpm alpha and from <1,000 to 4,000 dpm beta/gamma. Floor readings ranged from 1,400 to 7,000 dpm alpha and from <2,000 to 10,000 dpm beta/gamma.

During a March 12, 1996, radiological survey of the REDOX North Sample Gallery, a valve in a pipe above sample box number 146 was thought to be leaking. The pipe was used to return plutonium nitrate solutions from 233-S to REDOX's "E" cell. Since the REDOX Plutonium Loadout Hood was replaced by the 233-S facility, information about the residue from the leak would potentially provide analogous data regarding material contained within the Plutonium Loadout Hood piping. This leak prompted an investigation into the nature and source of the leaking material, because it indicated that piping may not have been completely drained and may have contained unknown material. A sample of residue from beneath the leak was collected as a nitric acid solution. The solution was shipped to the Plutonium Finishing Plant Laboratory to remove plutonium from the sample. The extract was analyzed at the 222-S Laboratory for nitrate, hexavalent chromium, and *Resource Conservation and Recovery Act of 1976* (RCRA) metals by inductively coupled plasma (ICP). It was found to contain high concentrations of plutonium and americium-241, plus notable concentrations of cadmium (30.2 parts per million [ppm]), chromium (601 ppm), and lead (44.4 ppm). The cadmium and chromium constituents in the sample were leached from piping by nitric acid solution. The lead constituent in the sample is suspected to be from oxidized shielding and paint in the immediate vicinity. The material would designate as a mixed waste (dangerous and radioactive) based upon the data. Nitrate was the dominant anion reported, and small quantities of common metals (aluminum, calcium, iron, nickel, magnesium, manganese, zinc, etc.) were also detected. An Occurrence Report (RL-BHI-DND-1996-0006) was generated, documenting the investigation.

To improve understanding of contaminant distributions in piping around the North Sample Gallery, a nondestructive assay (NDA) based on gamma spectral detection was performed on a number of pipes around the loadout hood and North Sample Gallery as well as some hood vessels. The NDA indicated that the pipes contained generally small quantities of residual plutonium, but that significant quantities of plutonium-239 remained in the E-16 and E-17 tanks. In addition, other transuranic (TRU) isotopes are suspected to be present. Calculations based on conservative assumptions estimated the plutonium-239 content at 1,450 g in E-16 and 650 g in E-17 (BHI 1997).

In the course of preparations for the NDA, radiological surveys conducted inside the hood revealed very high levels of removable contamination. For example, survey PS-202S-1177 indicated that floor contamination ranged between 3.5E+5 and 2.5E+6 dpm removable alpha, while the inside plexiglass wall contamination ranged between 2.1E+5 to 3.5E+5 dpm removable alpha. Contamination on the sides and top of the E-16 and E-17 vessels ranged from 1.4E+5 to1.5E+7 dpm removable alpha and 7,500 to 50,000 dpm removable beta/gamma. Alpha smear samples were typically not measured for beta/gamma due to concerns about contamination spread in lower background areas. Smear samples taken during the NDA program revealed lower levels of contamination on the plexiglass panels of 700 to 49,000 dpm removable alpha.

During one site visit, a video recording was made of the general facility layout. It is difficult to discern the nature of objects inside the hood because of poor lighting and dirty plexiglass. In general, pipes and vessels inside the hood do not appear to be covered with insulation or painted, as welds are readily visible. However, one vessel, E-16, has been painted silver and lettered in black paint. Some pipes outside the hood are insulated. Pipe runs appear to be formed out of single pieces of stainless steel pipe and are usually attached to vessels with flanged connections. In addition, valves in the hood are joined to piping or vessels by flanges. Asbestos gaskets may have been used at these locations.

1.1.3 Contaminants of Potential Concern

The principal COPCs for this SAP are the TRU materials. TRU wastes are defined as all wastes containing more than 100 nCi/g of alpha-emitting radionuclides with an atomic number greater than 92 and half-lives greater than 20 years.

The DQO process used process knowledge or previous investigations to identify the general radionuclide or chemical COPCs, listed below. The COPCs below are considered to be potential contaminants requiring additional assessment to see if they should be kept or rejected as COCs, or if they at least cannot be eliminated from further consideration.

Radionuclides
Pu-238/239/240/241/242
Am-241
Cm-244
Np-237

Mixed Fission Products (Cs-137, Sr-90)
Mixed Activation Products (Co-60)

Inorganics
Nitric acid (HNO_3)
Sulfuric acid (H_2SO_4)
Sodium dichromate (Na_2Cr_2O)
Ferrous sulfamate $Fe(NH_2SO_3)_2$
Cadmium
Chromium (total)
Nickel
Mercury (fluorescent lights, manometers, etc., suspected to be in the sump)
Tantalum
Hafnium
Lead

Organic Materials
Hexone (methyl isobutyl ketone [MIBK])
Oxalic acid
BUTVAR (rubberized fixative coating)
Polychlorinated biphenyls (PCBs) (Leaky electrical fixtures, analysis required by 222-S)

Construction Materials
Asbestos (flange gaskets, pipe insulation)
Lead-based paint (fixative coating)

Miscellaneous
Resins (233-S process hood overflow)
Debris (233-S-related fire residue, discarded hardware, dust and dirt).

Table 1-2 provides the locations at which these contaminants are expected to be concentrated in the loadout hood and process vessels. This information helped to identify waste stream characteristics and group loadout hood parts and process vessel and piping, accordingly.

Table 1-2. Contaminants of Potential Concern and Probable Plutonium Loadout Hood/Vessel Locations.

COPC	Inside E-16	Inside E-14	Inside E-15	Inside E-17	Inside E-18	Inside E-19	Inside E-20	Inside E-21	Inside Piping	Vessel/ Piping Exterior	Hood Floor and Walls	Sump
Pu-238	Tr.	?	?	Tr.	?	?	?	?	?	?	?	?
Pu-239	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-240	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-241	Tr.	?	?	Tr.	?	?	?	?	?	?	?	?
Am-241	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Np-237	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cm-244	?	?	?	?	?	?	?	?	?	?	?	?
Cs-137	?	?	?	?	?	?	?	?	?	?	?	?
Sr-90	?	?	?	?	?	?	?	?	?	?	?	?
Co-60	?	?	?	?	?	?	?	?	?	?	?	?
HNO_3	Y	?	?	Y	?	?	?	?	Y	N	Y	Y
H_2SO_4	Y	?	?	Y	?	?	?	?	Y	?	?	?
$NA_2Cr_2O_7$	Y	Y	Y	Y	?	?	?	?	Y	?	?	?
$Fe(NH_2SO_3)_2$	Y	?	?	Y	?	?	?	?	?	?	?	?
Cadmium	?	?	?	?	?	?	?	?	?	?	?	?
Chromium	Y	Y	Y	Y	?	?	?	?	Y	?	?	?
Lead	?	?	?	?	?	?	?	?	?	?	?	?
Nickel	?	?	?	?	?	?	?	?	?	?	?	?
Mercury	?	?	?	?	?	?	?	?	?	?	?	Y
Tantalum	Candidate alloy in stainless steel (Type 309), Cd)											
Hafnium	Candidate alloy in stainless steel (Type 309), Cd)											
Asbestos	Suspected at flanges with gasket seals											?
Lead, chrome, and cadmium (paint, as a fixative)	N	N	N	N	N	N	N	N	N	Y	N	Y
Hexone	Y	Y	Y	Y	Tr.	Tr.	Tr.	Tr.	Y	?	?	Y
Oxalic acid $(COOH)_2 2H_20$	?	?	?	?	?	?	?	?	?	?	?	Y
BUTVAR (Fixative)	?	?	?	?	?	?	?	?	?	?	?	?
PCBs	N	N	N	N	N	N	N	N	N			?
Ion exchange resins/debris (233-S)	N	N	N	N	N	N	N	N	N	N	N	Y?

Y = Contaminant expected to be found in "significant" quantities.
N = Contaminant not expected to be found.
Tr. = Contaminant expected to be found in "minor/detectable" quantities.
? = Contaminant's presence uncertain. Implies inclusion as analyte until proven not to exist in/on facility.

The waste streams resulting from loadout hood and process vessel /piping disassembly and decontamination are identified in Table 1-3. The waste streams will be tracked by number through the rest of the document.

Table 1-3. Plutonium Loadout Hood and Concentration Process Waste Streams.

Waste Stream	Waste Stream Description
1	Process contact vessels and piping
2	Process vapor vessels and piping
3	Loadout hood-internal and external surfaces; external vessel and pipe surfaces; gallery-level hood floor
4	Pit/sump walls and floors, miscellaneous pit/sump debris
5	Potential unknown media in process vessels/piping and/or loadout hood
6	For waste streams #3 and #4, decontamination waste, primarily damp cloth wipes, resulting from decontamination of the loadout hood's internal and external surfaces, external surfaces of vessels/piping, floors, pit/sump and debris

Table 1-4 provides the rationale for the disposition of the COPCs, whether deleted or kept as contaminants of concern (COCs) or COPCs, as indicated in the last column.

1.1.4 Radiological Hazards and Sampling Considerations

The existing data clearly show that the Plutonium Loadout Hood facility presents significant radiological hazards. The potential for a criticality has been evaluated and is considered to be not credible due to the expected form and geometry present. However, because of unknown conditions, caution is required and will be maintained by the use of engineering controls, administrative controls, and as low as reasonably achievable (ALARA) requirements throughout the field work.

The potential for cross-contamination and contamination spreading will require careful sampling technique and radiological monitoring. Sample analyses may pose problems because smearable alpha contamination levels of samples could potentially exceed onsite or offsite laboratory's acceptance criteria. Chemical extraction of plutonium or other TRU isotopes is a possibility, but can only be performed at qualified on-site facilities, such as the Plutonium Finishing Plant (PFP) laboratory.

Table 1-4. Contaminants of Potential Concern and Evaluation. (2 Pages)

COPC	Waste Stream(s)	COPC Evaluation	Remain a COPC (Y/N)
Radionuclide constituents			
Pu-238 (as nitrate)	**1, 2, 3, 4, 5**	Plutonium is common to all waste streams and dominates in quantity. Pu-238 is present in trace quantities.	Y
Pu-239/240 (as nitrate)	**1, 2, 3, 4, 5**	Prime process target. Plutonium is common to all waste streams and dominates in quantity.	Y
Pu-241	**1, 2, 3, 4, 5**	Pu-241 decays to Am-241. Pu-241 has a 14.4-year half-life and has, therefore, gone through >2 half-life cycles (?75% decay) since closure of this facility. Pu-241 activities may be adequately estimated from measured Pu-238, Pu-239/240, and Am-241 activities.	N
Am-241 (as nitrate)	**1, 2, 3, 4, 5**	Decay product of Pu-239. Potential tertiary process target, but not likely in waste streams in other than normal decay ratio.	Y
Cm-244 (as nitrate)	1, 2, 3	Potential tertiary process target. Not likely in waste streams in other than normal decay ratios.	Y
Np-237 (as nitrate)	**1, 2, 3, 4, 5**	Secondary process target.	Y
Cs-137	4	Not associated with plutonium concentration process. Likely source from cross-contamination from other areas of REDOX.	Y
Sr-90	4	Not associated with plutonium concentration process. Likely source from cross-contamination from other areas of REDOX	Y
Co-60	4	Not associated with plutonium concentration process. Likely source from cross-contamination from other areas of REDOX.	Y
Organic constituents			
Hexone $(CH_3)_2$ CH CH_2 CO CH_3	1, 2	Minor constituent in pre-concentrator feed and more concentrated in E-16 condensate system.	Y
Oxalic acid $(COOH)_2$ $2H_2O$	1, 2	Reported as a decontamination agent for 1967 system shut down. Use was followed with water rinses.	Y
BUTVAR	3	Candidate fixative for surface contamination inside hood and on vessel/pipe exterior. A nonregulated compound.	N

Table 1-4. Contaminants of Potential Concern and Evaluation. (2 Pages)

COPC	Waste Stream(s)	COPC Evaluation	Remain a COPC (Y/N)
Inorganic constituents			
HNO3	**1, 2**	rinses.	Y
N2SO4	1, 2	rinses.	Y
NA2Cr2O7	1, 2	rinses.	Y
Ferrous sulfamate $Fe(NH_2SO_3)_2$	1, 2	Potential process chemical.	Y
Cadmium	1, 2	Possible corrosion products inside vessels/pipes.	Y
Chromium	1, 2	Possible corrosion products inside vessels/pipes.	Y
Nickel	1, 2	Possible corrosion products inside vessels/pipes.	Y
Mercury	4	Source unknown, possible origin from broken instruments.	Y
Tantalum	1, 2	Tantalum is a known or suspected trace alloy in stainless steel vessels/pipes/appurtenances. Not reactive. Not hazardous.	N
Hafnium	1, 2	Hafnium is a suspected trace alloy in stainless steel vessels/pipes/appurtenances. Not reactive. Not hazardous.	N
Construction Materials			
Asbestos	1, 2	Asbestos in a minor (~1%) constituent in flange gaskets.	Y
Paint lead, chromium, and cadmium i	3	Rarely used, not noted on E-16 vessel.	Y
Miscellaneous			Y
Resins	4	Suspected 233-S source via process hood drains. Can be identified by visual inspection.	Y
Debris, undefined, unknowns	3, 4, 5	Consists of small metal parts, dust, and other undefined debris/detritus. Investigate for an unknowns encountered.	Y
Decontamination materials	6	Cloth damp wipes used to remove mobile contaminants from surfaces.	Y

1.2 Data Quality Objectives

The U.S. Environmental Protection Agency's (EPA) DQO procedure was used to support the development of this SAP (EPA 1994a). The DQO procedure is a strategic planning approach that provides a systematic procedure for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application. The seven steps that comprise the DQO process are as follows:

- Step 1: State the problem
- Step 2: Identify the decisions
- Step 3: Identify inputs to the decisions
- Step 4: Define the study boundaries
- Step 5: Develop decision rules
- Step 6: Specify limits on decision error
- Step 7: Optimize the design for obtaining data.

The information presented in this section is based on agreements reached through internal ERC DQO workshops held primarily between the project team. Regulatory concerns and inputs to the DQO process were achieved through interviews with the EPA.

1.2.1 Step 1: State the Problem

The Plutonium Loadout Hood and the Plutonium Concentration system have been identified for potential removal and disposal. At the present time, the types and quantities of both radiological and chemical contaminants within the Plutonium Loadout Hood and the process vessels and piping are not sufficiently identified to support decontamination and decommissioning (D&D) and waste characterization. Facility disassembly and disposal cannot be completed until the nature and distribution of the radiological and chemical contaminants associated with the loadout hood and process vessels/piping are known. The concentrations of COCs and COPCs must be determined for proper waste designation and disposal. The data will also be used to assess the worker safety controls and potential for a criticality and will control worker safety through implementation of ALARA goals appropriate to the level of radiological and chemical hazards inside the loadout hood.

Individuals and organizations within ERC, involved in the planning process, are presented in Table 1-5.

Table 1-5. REDOX Loadout Hood DQO Technical Team.

Name	Functional Role	Organization
R. Ovink	DQO Facilitator	CHI
L. Johnson	Regulatory Analysis	CHI
T. Allen	S&M Project Engineer	BHI
D. Encke	Technical Lead	CHI
C. Webb	Process Knowledge/Historical Data	BHI
D. Erb	Technical Support	CHI
G. Borden	Waste Designation	BHI
R. Winslow	Radiological Protection (H&S, ALARA)	THI
N. Kerr	Safety Analysis	BHI
M. Galgoul	D&D Characterization	CHI
R. Weiss	Analytical Support	CHI
W. Thompson	Sampling	BHI
J. Sharpe	Cultural Resources	CHI
S. Weiss/K. Gano	Biological/Ecological Resources	CHI/BHI
E. Coenenberg	Regulatory Analysis-Air Qual.	CHI
L. Davenport	Criticality Safety	BHI

ALARA As Low As Reasonably Achievable
BHI = Bechtel Hanford, Inc.
CHI = CH2M Hill-Hanford, Inc.
DQO = data quality objectives
H&S Health and Safety
S&M = surveillance and maintenance

1.2.1.1 Key Decision Makers. The key decision makers for the Plutonium Loadout Hood removal project are listed below. The lead regulatory agency for *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) actions at REDOX is EPA.

- P. S. Innis, EPA
- J. P. Sands, U.S. Department of Energy, Richland Operations Office
- A. D. Huckaby, Ecology

1.2.1.2 Schedule and Milestones. There are no *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994) milestones established for completion of collection of samples for isotopic and chemical concentrationsor the NDA for waste designation as low-level waste or TRU waste activities specified in this SAP. The SAP must be reviewed and approved by the EPA and RL prior to any sampling. A baseline change request has been approved that schedules initial sampling of the Plutonium Loadout Hood in June 1998, with a final characterization report issue in September 1998.The D&D of the Plutonium Loadout Hood will occur under a CERCLA removal action. Currently D&D

activities for the Plutonium Loadout Hood are not funded or scheduled. The results of the initial sampling and analysis will aid in determining the required scope, funding, and timeline for future D&D activities. It is anticipated that D&D of the Plutonium Loadout Hood will commence after completion of the 233-S Process Hood area. This will allow lessons learned from removal of 233-S Process Hood to be applied to the REDOX Plutonium Loadout Hood project.

1.2.2 Step 2: Identify the Actions

The goal of this SAP is to determine the radiological and chemical contaminants related to all materials to be disposed of that comprise the hood itself and the Plutonium Concentration vessels, piping and appurtenances. The waste streams associated with the Plutonium Loadout Hood removal have been identified and are listed in Table 1-3 (Section 1.1.3). Each waste stream is regarded as having different operational characteristics and COPCs or COCs and warrants separate sampling.

1.2.2.1 Principal Study Questions. Principal study questions provide the basis for determining how to solve the problem. These questions identify key unknown conditions or unresolved issues that reveal the solution to the problem being investigated. The following is a list of principal study questions that need to be resolved.

PSQ #1: Do the waste streams in the Plutonium Loadout Hood contain TRU materials in concentrations that exceed the TRU definition of 100 nCi/g?

PSQ #2: Do the waste streams in the Plutonium Loadout Hood contain chemical constituents in concentrations that cause them to be designated as dangerous waste?

1.2.2.2 Alternative Actions. The alternative actions that could be taken to resolve the principal study questions are presented in Table 1-6 and form the basis for defining the decision performance criteria specified in Step 6 of the DQO process (see Section 1.2.6). The consequences of the alternative actions assess the impact of the alternative relative to the baseline case both in terms of costs for corrective action and the risks related to recovery if the decision is wrong. The waste designation is required to be accurate and appropriate, and legal penalties may apply for improperly designated waste. Any wastes designated as dangerous or mixed waste come under land disposal restrictions, which require the waste to be properly treated prior to disposal.

1.2.2.3 Action Statements. This section combines the principal study question and the alternative action into a decision statement that expresses a choice among actions.

ACTION STATEMENT #1

Determine whether each piece of vessel/piping from the waste streams in the Plutonium Loadout Hood contains TRU constituents in concentrations that exceed the TRU waste definition of 100 nCi/g and therefore is designated as TRU waste. If those waste streams do not contain TRU constituents in concentrations that exceed the TRU waste definition of 100 nCi/g, they are designated as low-level radioactive waste.

DECISION STATEMENT #2

Determine if waste streams in the Plutonium Loadout Hood contain dangerous waste, low-level radioactive waste, mixed waste, dangerous waste, TRU waste, or TRU-mixed waste.

- If the sample obtained from the waste stream exceeds the dangerous waste criteria (WAC 173-303), then the waste stream must be treated as dangerous waste.
- If the contamination concentration exceeds the radiological waste criteria (DOE Order 5820.2A, *Radioactive Waste Management* [DOE 1998]), then the material is radioactive and must be treated as low-level waste.
- If the contamination concentration exceeds the mixed waste criteria (DOE Order 5820.2A, *Radioactive Waste Management* [DOE 1998]), then the material is radioactive and must be treated as a mixed waste.
- If the contamination concentration exceeds the TRU waste criteria (DOE Order 5820.2A, *Radioactive Waste Management* [DOE 1998]), then the material is radioactive and must be treated as a TRU waste.
- If the contamination concentrations exceed the dangerous waste criteria (WAC 173-303) and the TRU waste criteria as defined by DOE Order 5820.2A, *Radioactive Waste Management* DOE 1998, then the material must be treated as TRU-mixed waste.

Table 1-6. Alternative Actions and Consequences.

PSQ#-AA#	Alternative Action	Consequences of Alternative Action
TRU/Radioactive Waste Disposal Alternatives		
1-1	Sample and analyze media. Ship all waste as TRU, mixed waste, or low-level waste.	Cost Impact: Baseline Risk Impact: Baseline
1-2	No sampling or analysis. Designate as TRU based on process knowledge.	Cost Impact: Lower than baseline due to savings on sample/analysis costs that would offset higher TRU waste disposal costs. However, TRUSAF assay and detection of non-TRU waste will increase cost significantly due to additional sampling, reclassification, and handling. Risk Impact: Low/Insignificant
1-3	No sampling or analysis. Stabilize or isolate in place for future D&D actions.	Cost Impact: Moderate; estimated to be equal to or greater than removal. Risk Impact: Moderate to high. Contamination remains in place. Effectiveness of stabilization/isolation versus increased potential mobility is unknown. Will increase waste volume and COPCs for final disposal. Unacceptable approach.
1-4	No sampling or analysis. No action	Cost Impact: Much less than baseline. Risk Impact: Moderate to high. Continuing impacts to plant surveillance personnel, remote monitoring limitations. Unacceptable approach.
1.2.2.1 DANGEROUS WASTE DISPOSAL ALTERNATIVES		
2-1	Sample and analyze. Designate as dangerous waste or nondangerous waste.	Cost Impact: Baseline Risk Impact: Baseline
2-2	No sampling and analysis. Designate as dangerous waste based on process knowledge.	Cost Impact: Lower than baseline due to savings on sample/analysis costs that would offset higher dangerous waste disposal costs. Risk Impact: Low
2-3	No sampling or analysis. Stabilize or isolate in place for future D & D actions.	Cost Impact: Moderate, estimated to be equal or greater than removal. Risk Impact: Moderate to high. Contamination remains in place. Effectiveness of stabilization/isolation versus increased potential mobility is unknown. Will increase waste volume and COPCs for final disposal. Unacceptable approach.
2-4	No sampling or analysis. No action	Cost Impact: Much lower than baseline. Risk Impact: Moderate to high. Continuing impacts to plant surveillance personnel, remote monitoring limitations. Unacceptable approach.

COPCs = contaminants of potential concern
D&D = decontamination and decommissioning
TRU = transuranic
TRUSAF = Transuranic Waste Storage and Assay Facility

1.2.3 Step 3: Identify Inputs to the Action Statements

Inputs required to address the action statements and determine required sampling activities analytes for each waste stream in Table 1-3 are presented in Table 1-7.

1.2.4 Step 4: Define the Study Boundaries

The maximum physical boundaries of the study area will be the volume encompassed by the Plutonium Loadout Hood and includes the vessels, pipes, and appurtenances in the hood. Pipes exiting the hood connect the 233-S and 202-S Buildings and are not considered in this SAP. Within the loadout hood, concrete floors and walls in the pit and sump as well as the concrete at the gallery floor level are not considered part of the decontamination process, beyond that required to clean up smearable contamination for safety reasons. Likewise, the loadout hood's ventilation system, which connected to the REDOX plant ventilation system, is not considered to be part of this SAP. There are no temporal constraints or boundaries placed on this SAP.

There are six waste streams shown in Table 1-7 for which sampling and analysis inputs are identified. Of these waste steams, two share similar characteristics. Waste streams #1 and #3 are considered identical as they share a common source of contaminants, the liquid process chemistry. The other four waste streams are unique in their waste processes and contaminants. The sump (waste stream #4) is the low point collection area for the loadout hood and is expected to be the "worst case" with respect to COPCs.

1.2.5 Step 5: Develop Action Rule

The following action rules summarizes the attributes the decision maker needs to know about the sample population and how this knowledge will guide the selection of a course of action to solve the problem.

1.2.5.1 Parameters of Interest. There are insufficient analytical data for the loadout hood waste streams to provide a basis for statistical sampling. A sampling design based on professional judgement will be used. The parameter of interest will be a single analytical value for every constituent in each stream that will be compared against the action levels.

1.2.5.2 Action Levels. Action levels are the threshold values that provide the criterion for choosing between the alternative actions. The action levels may be based on regulatory thresholds or problem-specific standards. Table 1-8 provides the numerical action levels and identifies the bases for their selection.

Table 1-7. Decommissioning Waste Designation Inputs by Media, Source, and Sources of Information/Data.

Waste Stream	Inputs/Media	Use	Data Ready (Y/N)	Source
1, 2	TRU, mixed fission product concentrations/vessels and piping	Waste designation: safety assessment for criticality prevention and ALARA assessment	N	Sampling and analysis of vessels and piping internal surfaces
	Dangerous materials (metals, anions, organics) concentrations/ vessels and piping	Waste designation	N	
3	Radiological material concentrations/Plutonium Loadout Hood surfaces	Waste designation: input to criticality assessment, ALARA assessment for D&D worker protection	N	Sampling and analysis of loadout hood internal and external surfaces
	Inorganics – metals and anion concentrations/ Plutonium Loadout Hood surfaces	Waste designation, ALARA assessment for D&D worker protection		
	TRU, mixed fission product concentrations/ exterior vessel surfaces	ALARA assessment for D&D worker protection		
	Inorganics – metals and anion concentrations/ Plutonium Loadout Hood surfaces	Waste designation, ALARA assessment for D&D worker protection		
4	TRU material, mixed fission product concentrations/ sump sludge and debris	Waste designation, criticality assessment, ALARA assessment for D&D worker protection		
	Inorganics – metals and anions concentrations/ sump sludge, debris	Waste designation, ALARA assessment for D&D worker protection		
	Organic material concentrations/ sump sludge, debris	Waste designation, ALARA assessment for D&D worker protection		
5	TRU material, mixed fission product concentrations/ contingency for unknown accumulations in loadout hood, vessels, and piping	Waste designation, criticality assessment, ALARA assessment for D&D protection		
	Inorganics- metal and anion concentrations/ contingency for unknown accumulations in loadout hood, vessels, and piping	Waste designation, ALARA assessment for D&D protection		
	Organic material concentrations/contingency for unknown accumulations in loadout hood, vessels and piping.	Waste designation, ALARA assessment for D&D protection		
	Characteristic waste codes/ contingency for unknown accumulations in loadout hood, vessels, and piping	Waste designation, ALARA assessment for D&D protection		
6	Decontamination wastes/wipes, miscellaneous materials	Waste designation, ALARA		Sampling and analysis of decontamination materials

ALARA = as low as reasonably achievable
D&D = decontamination and decommissioning
TRU = transuranic

Table 1-8. Decision Levels for the COPCs.

Constituent	Action Level	Source
TRU	100 nCi/g	ERDF Acceptance Criteria
Am-241[a]	0.05 Ci/m^3	ERDF Acceptance Criteria
Pu-239/240[a]	2.9 E-2 Ci/m^3	ERDF Acceptance Criteria
Cs-137	32 Ci/m^3	ERDF Acceptance Criteria
Sr-90	1.4 E4 Ci/m^3	ERDF Acceptance Criteria
Co-60	No limit in g. Short half-life.	ERDF Acceptance Criteria
Np-237[a]	1.5 E-3 Ci/m^3	ERDF Acceptance Criteria
Pu-238[a]	1.5 Ci/m^3	ERDF Acceptance Criteria
Pu-241/242	6.2 Ci/m^3	ERDF Acceptance Criteria
Hg	1,000 mg/kg	ERDF Acceptance Criteria
Cr+6 and Cr (total)	5.9E+4 mg/kg	ERDF Acceptance Criteria
Pb	5,000 mg/kg	ERDF Acceptance Criteria
Cd	3.9E+4 mg/kg	ERDF Acceptance Criteria
RCRA characteristic waste	Toxicity: TCLP levels Ignitability[b]: Flash pt <140°F Corrosivity: pH≤2 or ≥12.5 Reactivity[c]: Unstable, violent change, explosive	WAC 173-303, Sec. 70-100
Hexone	33 mg/kg	ERDF Acceptance Criteria
Asbestos	1%	ERDF Acceptance Criteria
PCB	500 mg/kg	ERDF Acceptance Criteria

ERDF = Environmental Restoration Disposal Facility
RCRA = *Resource Conservation and Recovery Act of 1976*
TCLP = Toxicity Characteristic Leaching Procedure
WAC = *Washington Administrative Code*

[a]ERDF limit is lower of indicated value and transuranic limit of 100 nCi/g.

[b]Ignitability is not an issue based on the identified COPCs, with the exception of hexone. Hexone is not viewed as an ignitability concern based on the length of time that the process area has been in final shutdown.

[c]Reactivity: The testing for cyanide and sulfide is not necessary because they cannot be present in an acidic environment.

1.2.5.3 Developing Action Rules. The rules for each action identified in DQO Step 2 (see Section 1.2.2) are summarized below. These "if...then..." statements describe what action will be taken based on the results of the data collection.

Action Rule 1:

If the analytical results indicate that the sample media has a TRU material concentration of 100 nCi/g or greater, it will be designated as TRU waste. If the analytical results indicate that the material has a TRU material concentration of less than 100 nCi/g, it is designated as low-level radioactive waste.

Action Rule 2:

If analytical results indicate that the media contains leachable concentrations of dangerous constituents above those specified in Table 1-9, then the media will be designated as a dangerous waste, treated as required, and disposed of to a mixed-TRU, mixed, or dangerous waste storage facility. Land Disposal Restrictions apply. If analytical results indicate that the media contains leachable concentrations of dangerous constituents less than those specified in Table 1-9, then the media will be designated as a nondangerous waste.

It is required that the results of both action rules will be combined to assure a proper waste designation for each part of the Plutonium Loadout Hood and process equipment.

1.2.6 Step 6: Specify Limits on Action Errors

Because a statistical sampling design was not deemed necessary or feasible for the Plutonium Loadout Hood, professional judgement design is applied. Therefore, Step 6 does not apply.

1.2.7 Step 7: Optimize the Design for Obtaining Data

The sampling design for the Plutonium Loadout Hood is based on a "worst case" sampling approach that identifies the accessible locations where samples are expected to provide sufficient information and control to guide the decontamination and decommissioning phase using NDA analyses for waste designation. Table 1-10 summarizes the details of the Phase I and Phase II sampling program. Details of the sampling plan are provided in Section 3.2.

Table 1-9. Data Quality Requirements Summary. (2 Pages)

Contaminant of Potential Concern	Analytical Callout	Analytical Technique	Commercial Laboratory Detection Limits[a]		Onsite Laboratory Detection Limits[a]		Regulatory Limits[a c]	Laboratory Accuracy and Precision[d]
			Solid[b]	Liquid[b]	Solid[b]	Liquid[b]		
Pu-238/239/240/241/242	Pu isotopic	Alpha energy analysis	1 20	1 20	20,000	200		--
Am-241, Cm-244	Am/Cm isotopic	Alpha energy analysis	1 20	1 20	20,000	200		--
Np-237	Np-237	Alpha energy analysis	1 20	1 20	20,000	200		--
Cs-137	GEA	Gamma energy analysis	0.1 1	15 100	10,000	100	10	--
Co-60	GEA	Gamma energy analysis	0.1 1	15 100	10,000	100	10	--
Sr-90	Total rad. Sr	Beta counting	1 5	2 10	5,000	50	10	--
Gross alpha	Gross alpha	Proportional counting	10 25	3 7	10,000	100		--
Gross beta	Gross beta	Proportional counting	15 30	4 8	30,000	300		--
Chromate, SS steel corrosion-chromium	Total Cr	Inductively coupled plasma spectrography -- SW-846-6010A	0.5 5	3 20	10	50	5 100	--
Lead-based paint, bulk lead	Total Pb	Inductively coupled plasma spectrography – SW-846-6010A	20 40	250 500	100	400	5 100	--
Cadmium-based paint	Total Cd	Inductively coupled plasma spectrography – SW-846-6010A	1 5	5 10	5	30	1 20	--
SS Steel corrosion-nickel	Total Ni	Inductively coupled plasma spectrography – SW-846-6010A	4 10	20 100	20	100		--
Mercury	Total Hg	CVAA - SW-846-7471	0.1 15	0.5 2	0.5	5	0.2 4	--
Lead – toxicity	TCLP – Pb	Extraction – ICP – SW-846-1311/6010A	Extract[e]	250 500	Extract[e]	400	5 100	--
Nickel – toxicity	TCLP – Ni	Extraction – ICP	Extract[e]	20 100	Extract[e]	100		--
Chromium – toxicity	TCLP – Cr	Extraction – ICP	Extract[e]	3 20	Extract[e]	50	5 100	--
Cadmium - toxicity	TCLP – Cd	Extraction – ICP	Extract[e]	5 10	Extract[e]	30	1 20	--
Mercury – toxicity	TCLP – Hg	Extraction – CVAA SW-846-1311/7470	Extract[e]	0.5 2	Extract[e]	5	0.2 4	--
HNO_3	Anions – nitrate, nitrite	Ion chromatography EPA 300.0	0.1 5	10 50	N/A	10,000		--
H_2SO_4, $Fe(NH_4)_2(SO_4)_2$	Anions, sulfate	Ion chromatography EPA 300.0	2 10	150 700	N/A	15,000		--

Table 1-9. Data Quality Requirements Summary. (2 Pages)

Contaminant of Potential Concern	Analytical Callout	Analytical Technique	Commercial Laboratory Detection Limits[a]		Onsite Laboratory Detection Limits[a]		Regulatory Limits[a,c]	Laboratory Accuracy and Precision[d]
			Solid[b]	Liquid[b]	Solid[b]	Liquid[b]		
Oxalic acid	Anions - oxalate	Ion chromatography EPA 300.0			N/A	15,000		--
Acids	PH	Electrode/paper SW-846-9040/9041A	0.1 0.1	0.1 0.1	0.1 0.1	0.1 0.1	2.0<pH pH >12.5	--
Hexone	Volatile organic	Gas chromatography/ mass spectrography SW-846-8260A	.002 .002	1 1	N/A	N/A		--
PCBs	PCBs	Gas chromatography SW-846-8082	0.05 10	0.5 100	10	50	10	--
Asbestos	Asbestos	Microscopy	N/A	N/A	<1%	<1%		--

CVAA = cold vapor atomic adsorption
GEA = gamma energy analysis
ICP = inductively coupled plasma
N/A = not applicable
PCB = polychlorinated biphenyl
TCLP = toxic characteristic leaching procedure

[a]First value is for "full protocol," the second value is for rapid turnaround or reduced volume analysis. "Full protocol" detection limits require larger volumes shown in Table 1-11.

[b]Detection limit values are in pCi/g or mg/kg for solids, and pCi/L or µg/L for liquids.

[c]Values for regulatory limits are specified for liquids and solids, respectively. Liquids are in units of mg/L or pCi/L. Solids are in units of mg/kg or pCi/g.

[d]Precision and accuracy requirements for both commercial and onsite laboratories are established prior to testing. The basis for measurements accuracy and precision is specified in Volume 4, Section 7 of DOE-RL (1996).

[e]TCLP values are reported as liquid extract concentration for solid samples and bulk liquid concentrations for liquid samples.

Table 1-10. Sampling Program for the REDOX Loadout Hood.

Waste Stream	Sampling Location	Frequency	Sample Type	Size [a]
Phase I and/or Phase II Sampling				
1[b]	Field locate capped process outlet pipe extending from E-17 Concentrator vessel toward the east end of the Plutonium Loadout Hood.	One	Residue on internal surface of pipe	2-25
2	Field locate and break flanged pipe connection in vicinity of E-15 Pre-concentrator condenser.	One	Residue on internal surface of pipe	2-25
4	Field locate sump in pit section of the Plutonium Loadout Hood. Take vertically oriented sample with a small diameter aluminum tube to include all strata of debris in sump.	One	Representative solid debris sample	2-25
5	Field locate during sampling or disassembly/decontamination at location encountered.	One per unknown	Representative solid or liquid sample	2-25/ 100
6	Decontamination wipe/rag.	One per waste container[c]	Representative contaminated wipe/rag	N/A
Phase II Only				
1,2	Process Vessels/Piping, Plutonium Loadout Hood components.	One per piece[d]	Representative NDA location per piece of vessel/pipe	N/A

NDA = nondestructive assay

[a]Sample size stated for onsite and offsite (X-Y) laboratories, respectively. Samples are presumed to be solids and are specified in grams, except for waste stream #5 where solids or liquids may be encountered. Sample size will be dictated by the amount of available material and field surveys of sample. Radiological shipping and handling/exposure requirements may require reduction in the amount of sample sent to the laboratory, which will impact accuracy of laboratory measurements.

[b]Sample 1 will also serve for waste stream #3 as a bounding case.

[c]Assumes segregation of waste stream #6 from others during field activities.

[d]Piping and vessels may require cutting for packaging requirements.

2.0 QUALITY ASSURANCE PROJECT

The following section identifies the individuals or organizations participating in the project and discusses specific roles and responsibilities. This section also discusses the quality objectives for measurement data and discusses the special training requirements for the staff performing the work.

2.1 Project Management

This section addresses the basic areas of project management and will ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planned outputs have been appropriately documented.

2.1.1 Project/Task Organization

The sampling effort will be coordinated through the ERC organization on behalf of the DOE.

- The BHI Facility Surveillance and Maintenance Operations group, will provide project management and project engineering support for actual planning and conduct of the sampling phase. The BHI Decommissioning Projects group will be responsible for the subsequent disassembly and waste disposal. These organizations will arrange for all engineering and project support.

- The CH2M Hill-Hanford, Inc. (CHI) Sampling and Characterization group shall provide personnel to support field activities including sample collection, sample packaging, and sample shipment. The Sampling and Characterization group shall also coordinate analytical services and provide data management support through the Sample Management function.

- The BHI Sampling and Data Management group shall provide oversight of sampling and characterization activities.

- BHI shall provide field support and field engineering.

- BHI Safety and Health shall provide safety support.

- BHI Safety Analysis shall provide criticality support and oversight to planning and field activities.

- The BHI Assessment and Environmental Compliance group shall be responsible for performing independent quality assurance (QA) activities.

An organization chart for the sampling and decontamination/disposal of the Plutonium Loadout Hood will be presented.

2.1.2 Quality Objectives and Criteria for Measurement Data

The detection limits and precision and accuracy requirements for each of the analyses to be performed are to be defined as described in Table 1-9.

2.1.3 Special Training Requirements/Certification

Training or certification requirements needed by personnel are described in BHI-HR-02, *ERC Training Procedures*, and BHI-QA-03, *ERC Quality Assurance*, Plans 5.1 and 5.2. Field personnel shall have completed the following training before starting work: Radiation Worker II, Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training, etc. In addition, other training may be identified in the training matrix included in the work package.

2.1.4 Documentation and Records

Sample collection and analysis activities shall be planned in accordance with BHI-EE-01, *Environmental Investigation Procedures*, Procedure 1.4, "Documentation and Records," and Procedure 2.0, "Sample Event Coordination." The Sample Authorization Form/Field Sampling Requirements information generated through the sample event coordination process shall specify the sampling container, size, and preservatives; onsite measurements test methods; and laboratory analytical methods, turnaround times and data deliverable types. Careful coordination with Radiological Protection is required to minimize sample volumes and potential radiological exposures associated with sample collection, packaging, and shipping.

Field documentation shall be maintained in accordance with BHI-EE-01, including the following procedures:

- Procedure 1.5, "Field Logbooks"
- Procedure 1.13, "Environmental Site Identification and Information Reporting"
- Procedure 3.0, "Chain of Custody."

2.2 Measurement/Data Acquisition

The following section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory quality control (QC). This section also addresses the requirements for instrument calibration and maintenance, supply inspections, and data management.

2.2.1 Sampling Methods Requirements

The procedures to be implemented in the field should be consistent with those outlined in SW-846, *Test Methods for Evaluating Solid Waste* (EPA 1994b); DOE/EM-0089T, *DOE Methods for Evaluating Environmental and Waste Management Samples* (DOE 1994); BHI-EE-01, *Environmental Investigations Procedures*; and BHI-SH-04, *Radiological Control Work Instruction*, including the following:

- Procedure 6.2, "Establishing Radioactive Control Areas"
- Procedure 6.3, "Radiological Material Shipment Surveys"
- Procedure 6.4, "Radiological Material Labeling and Packaging."

2.2.2 Sample Handling and Custody Requirements

All sample handling, shipping, and custody requirements should be performed in accordance with BHI-SH-04, Procedure 6.3, "Radiological Material Shipment Surveys," and Procedure 6.4, "Radiological Material Labeling and Packaging." In addition, sample handling, shipping, and custody requirements will be performed according to BHI-EE-01, Procedure 3.1, "Sample Packaging and Shipping;" Procedure 3.0, "Chain of Custody;" and Procedure 4.2, "Sample Storage and Shipping Facility."

2.2.3 Sample Preservation, Containers, and Holding Times

Sample preservation, container, and holding times may be impacted by expected high TRU contaminant concentrations and resulting handling restrictions, potential requirements for laboratory or field extractions, etc. These requirements may adversely affect holding times for certain constituents and the ability to analyze for other constituents. Sample preservation and container details will be addressed in the Sampling Authorization Form/Field Sampling Requirement (SAF/FSR) in accordance with BHI-EE-01, EIP 2.0, "Sample Event Coordination."

2.2.4 Analytical Methods Requirements

Analytical methods requirements are identified in Table 1-9. The requirements for the project analytical needs are defined in Table 1-9 by the callouts for Analytical Technique, Detection Limits, and Laboratory Accuracy and Precision (as referenced in the applicable protocol and *Hanford Analytical Services Quality Assurance Requirements Document* [HASQARD]). These requirements will be worked with the appropriate laboratory so that project needs are met. Specific field methods have not been identified and will be addressed in the specific field instruction guide/work instruction.

2.2.5 Quality Control Requirements

When performing this field sampling effort, care shall be taken to prevent cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity. The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Deviations shall be controlled in accordance with BHI-EE-01, Procedure 2.7, "Sample Disposition Record."

QC requirements for the field sample collection process are as follows:

One equipment blank using deionized water, or a minimum of one equipment blank per every 20 samples of the same matrix, will be collected.

Equipment blanks are analyzed for the same analytes as samples collected using the equipment. Sample results shall be evaluated to determine the possible effects of contamination detected in the equipment blank.

A trip blank will accompany each cooler that contains samples that will be analyzed for volatile organics. Trip blanks are used to detect contamination during sample shipping and handling. A trip blank consists of an analyte sample container filled with deionized water.

Specific sampling instructions will be included in the work packages.

Laboratory QC requirements shall comply with SW-846 (Table 1-11).

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All field screening and analytical instruments shall be tested, inspected, and maintained in accordance BHI-QA-03, Procedure 5.2, "Onsite Measurements Quality Assurance Program," and Procedure 5.3, "Onsite Radiological Measurements Quality Assurance Program Plan." The results from all testing, inspection, and maintenance activities shall be recorded in a bound logbook in accordance with procedures outlined in BHI-EE-01, Procedure 1.5, "Field Logbooks." All NDA testing, inspection, and maintenance requirements will be specified in the contract procuring NDA services.

Table 2-1. Laboratory Quality Control Requirements.

Sample Type	Frequency	Purpose
Blank	One per batch, as appropriate to the method	To determine the existence and magnitude of possible contamination encountered during the sample preparation and analysis process
Matrix spike	One per batch, as appropriate to the method	A sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used as a measure of recovery.
Matrix spike duplicate	One per batch, as appropriate to the method	A second aliquot of the same sample as the matrix spike with the same known quantities of analytes added as the matrix spike. It is used to estimate method precision.
Sample duplicate	One per batch, as appropriate to the method	A second aliquot of the sample analyzed for the same constituents using the same analytical procedures. It is used to estimate method precision.

2.2.7 Instrument Calibration and Frequency

All field screening and onsite analytical instruments shall be calibrated in accordance with BHI-QA-03, Procedure 5.2, "Onsite Measurements Quality Assurance Program," and Procedure 5.3, "Onsite Radiological Measurements Quality Assurance Program Plan." The results from all instrument calibration activities shall be recorded in a bound logbook in accordance with procedures outlined in BHI-EE-01, Procedure 1.5, "Field Logbooks." Tags will be attached to all field screening and onsite analytical instruments, noting the date when the instrument was last calibrated, along with the calibration expiration date. All NDA calibrations will be according to contract specifications for procurement of NDA services.

2.2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Sampling supplies and consumables will be provided by the Sampling and Analytical Services group as specified on the SAF/FSR. In addition, the Sampling and Analytical Services group will be responsible for meeting bottle preservation requirements. It is possible that sample volume requirements may exceed radiological control requirements. Agreements must be reached on priority of contaminant importance and on recovery strategies in the event that sampling/analytical requirements conflict with radiological controls or shipping limits.

2.2.9 Data Management

Data resulting from the implementation of this SAP will be managed and stored by the ERC's Sample Management organization in accordance with BHI-EE-01, Section 2.0, "Sample Management."

All reports and supporting analytical data packages shall be subject to final technical review by qualified reviewers before their submittal to regulatory agencies or inclusion in reports or technical memoranda, at the direction of the BHI Project Task Lead. Electronic data access, when appropriate, shall be through computerized databases (i.e., the Hanford Environmental Information System). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. 1994).

2.2.10 Field Documentation

Field documentation shall be kept in accordance with BHI-EE-01, *Environmental Investigation Procedures*, including the following procedures:

- Procedure 1.5, "Field Logbooks"
- Procedure 1.13, "Environmental Site Identification and Information Reporting"
- Procedure 3.0, "Chain of Custody."

In addition, documentation for the surveying, handling, and shipping of radiological materials will be performed in accordance with BHI-SH-04, *Radiological Control Work Instructions*.

2.3 Assessment/Oversight

2.3.1 Assessments and Response Actions

The Compliance and Quality Programs group may conduct random surveillance and assessments in accordance with BHI-MA-02, *ERC Project Procedures*, Procedure 2.9, "Surveillances," to verify compliance with the requirements outlined in this sampling and analysis instruction, project work packages, the BHI Quality Management Plan, and BHI procedures and regulatory requirements. Deficiencies identified by one of these assessments shall be reported in accordance with BHI-MA-02, Procedure 5.3, "Self-Assessments". When appropriate, corrective actions will be taken by the Project Engineer in accordance with *the Hanford Analytical Services Quality Assurance Requirements Document*, Volume 1, Section 4.0 (DOE-RL 1996) to minimize recurrence.

2.3.2 Reports to Management

Management shall be made aware of all deficiencies identified by the self-assessments and shall be reported in accordance with BHI-MA-02, Procedure 5.3, "Self-Assessments."

2.4 Data Validation and Usability

2.4.1 Data Review, Validation, and Verification Requirements

Data verification and validation is performed on analytical data sets, primarily to confirm that sampling and chain-of-custody documentation is complete, sample numbers can be tied to the specific sampling location, samples were analyzed within the required holding times, and analyses met the data quality requirements specified in the sampling and analysis instruction.

2.4.2 Validation and Verification Methods

All data verification and validation shall be performed in accordance with BHI-EE-01, Procedure 2.5, "Data Package Validation Process," WHC-SD-EN-SPP-001, *Data Validation Procedures for Radiochemistry Analyses* (WHC 1993a); and WHC-SD-EN-SPP-002, *Data Validation Procedures for Chemical Analyses* (WHC 1993b). Level C data validation has been selected per procedures contained in WHC (1993a) and WHC (1993b) for commercial laboratory sample analysis results. Validation will be performed comparable to the Level C requirements of WHC (1993, 1993b) for onsite fixed laboratory results. This allows review of all QC data, transcription error verification, and holding time review. This level is the middle validation level and does not require review of raw data and/or recalculation of data. Should the Level C review find problems with the results, the project reserves the option of requiring recalculation and/or review of the raw data.

2.4.3 Reconciliation with User Requirements

A data quality assessment shall be performed on the resulting analytical data in accordance with *Guidance for Data Quality Assessment* (EPA 1996). The data quality assessment is a scientific and statistical evaluation of the data set to determine if the data are the right type, quality, and quantity to support their intended use. This evaluation entails the following:

- Reviewing the DQO including study objectives, statistical hypotheses, decision error, and sample design
- Reviewing analytical data, including data packages, QA reports, calculating statistical-based quantities, and graphical representation
- Selecting and performing statistical tests
- Verifying the assumptions of the statistical tests

- Determining corrective actions
- Drawing conclusions from the data
- Interpreting and communicating the test results.

3.0 FIELD SAMPLING PLAN

3.1 Sampling Objectives

The objective of the field sampling plan (FSP) is to clearly identify the sampling and analysis activities needed to resolve the decision rules identified in Step 5 of the DQO process (see Section 1.2.5). The FSP takes the sampling design proposed in Step 7 of the DQO process (see Section 1.2.7) and presents this design in Sections 3.2.1 through 3.2.7 below.

3.2 Sampling Locations and Frequency

Several unknown physical conditions are posed by the Plutonium Loadout Hood creating uncertainties, such as the use of sampling equipment and accessibility. Therefore, the key to success of the characterization effort lies within efforts conducted in the field. The following describes the general field approach. Specific sampling instructions will be included in an approved work package.

The field sampling will be conducted using a phased approach. The first step in Phase I will observe specific facility conditions to identify accessible sample locations. Exact sample locations will be determined through consultations with characterization team members, including RL and EPA. An electronic mail message will be sent to the DOE-AME 233-S Program Manager that will identify sample points, special sampling equipment, and sample analyte priorities, if there is not enough sample volume to run all analyses. Detection limits, precision and accuracy requirements would also be identified if they are different from those identified in the Hanford Analytical Services Quality Assurance Requirements Documents (DOE-RL 1996). Upon DOE's concurrence, the message would be electronically forwarded to the EPA for approval. Upon receipt of EPA's approval, the document would be entered into BHI Document and Information Services' DOCS Open System, which would assign a document number to the approved message for future tracking. Samples will be collected as the last step of Phase I.

Phase I sampling sets up the Phase II activities of Plutonium Loadout Hood and Plutonium Concentration vessel/piping disassembly, decontamination, waste designation, and disposal. Phase II utilizes NDA techniques as a means of determining radioactive and chemical inventory for each piece of equipment through an extrapolation process based on Phase I data. Phase I data on the individual waste streams, particularly waste streams #1 and # 4, will have known concentrations of specific TRU constituents, radionuclides, metals, anions, and organics. Phase II NDA interrogation of each vessel and pipe removed will quantify one or several radionuclides and pro-rated quantities of all COCs and COPCs per the inside volume of each pipe or vessel can then be calculated. Phase II planning activities will be determined through consultations with the characterization team, including RL and EPA and may require coordination with the Hanford

Site's Safeguards group if sampling results from Phase I indicate there are removable Category I quantities of plutonium.

Decontamination of the gallery floor and sump/pit wall and floor surfaces will be for the purposes of mitigating criticality and ALARA concerns only. In-depth floor decontamination and disposal will be addressed by REDOX facility decommissioning plans.

Phase I Sampling Program

The Phase I sampling activity will consist of obtaining discrete samples from "worst case" locations within and around the Plutonium Loadout Hood. Inductively coupled plasma (ICP) analyses for metals will be performed where chemical contaminants are suspected. Results may need to be confirmed by toxicity characteristic leach procedure (TCLP) analysis to evaluate dangerous waste constituents and land disposal restrictions. The TCLP is specified for unknown samples. An unknown is defined as an unexpected material, but specific characteristics are difficult to identify. An unknown would include any liquid encountered in the vessels/piping, any regular (crystalline) form encountered, or any unusual-colored material found in either vessels/piping or in the loadout hood. Alternate sampling locations should be determined from both process knowledge and safety requirements for at least waste streams #1. Allowance for unknown media, when encountered, is provided by waste stream #5 samples. Each is described below.

3.2.1 Waste Stream #1 Sample - Process Liquids Vessels and Piping

One sample will be taken from the line 1335 1" (P) (see H-2-008754, Piping, General Arrangement, Elevations and Sections, PR Room, Sheet #1, Sec B-B' & Sec D-D', line 1335 1" [P]), which connected the E-17 Concentrator vessel to the PR can. This line was partially decommissioned with the removal of the PR can and a segment of the Plutonium Loadout Hood. This line is expected to be capped at some location away from E-17. The amount of pipe removed is unknown and needs to be determined prior to sampling. The cap needs to be removed and replaced after sampling. Caution is required when opening pipe for remote potential of liquids in the line. If 1335 1" (P) is absent, 1254 1" (P) may be an adequate alternative. An evaluation of alternate sample sites requires prior approval of Nuclear Safety and Radcon Engineering. The 1254 1" (P) line was part of the vacuum transfer system and may have collected vaporized residue during the transfer process. The sample will be of available residual material and may require scraping of the interior pipe wall. The sample will be analyzed for radiological constituents and dangerous constituents, specifically metals and anions.

The parameters of interest for this sample are radiological and chemical in nature. The COPCs for the process liquids vessels and piping include the following:

TRU – concentration and isotopic distribution for Pu, Am, Np, and Cm (see Section 1.1.3)
Fission/Activation Products – Co-60, Cs-137, Sr-90 (GEA, Sr-90, gross alpha/beta)

Heavy Metals – chromium. cadmium. lead. nickel (ICP/TCLP methods): mercury (cold vapor atomic absorption [CVAA])
Organics – hexone. oxalic acid as oxalate.
Inorganics – nitric acid as nitrates and nitrites. sodium dichromate as total Cr. sulfuric acid as sulfates. ferrous sulfamate as sulfates.

NOTE: Sampling open pipe for stainless steel corrosion products should be considered for this event if acceptable published corrosion data are not available.

3.2.2 Waste Stream #2 Sample – Process Condensate Vessels and Piping

One sample will be taken from a field located line associated with the E-15 Pre-Concentrator Condenser unit. A location will not be specified. Field determination by Criticality and RPT Engineers is needed to ensure that breaking a piping connection around the E-15 vessel is safe. If broken. the line will need to be reassembled or both segments blind flange-capped (preferred). Caution is required when opening pipe for remote potential of liquids in the line. The sample will be of available residual material and may require scraping of the interior pipe wall. The sample will be analyzed for radiological constituents and dangerous constituents. specifically metals and anions. The sample will also be analyzed for organics. particularly hexone.

The parameters of interest for this sample are primarily radiological and chemical in nature. The COPCs for the process condensate vessels and piping include the following:

TRU – concentration and isotopic distribution for Pu, Am, Np, and Cm (see Section 1.1.3)
Fission/Activation Products – Co-60, Cs-137, Sr-90 (GEA, Sr-90, gross alpha/beta)
Heavy Metals – chromium, cadmium, lead, nickel (ICP/TCLP methods): mercury (CVAA)
Organics – hexone, oxalic acid
Inorganics – nitric acid, sodium dichromate, sulfuric acid, ferrous sulfamate

NOTE: Sampling open pipe for stainless steel corrosion products should be considered for this event if acceptable published corrosion data is not available.

3.2.3 Waste Stream #3 Sample – Plutonium Loadout Hood Interior and Exterior Surfaces, Vessel and Piping Exterior Surfaces, and Hood Gallery Floor Surfaces

Because of the confined nature of the Plutonium Loadout Hood and the mobility of plutonium nitrate solutions, spills from the PR can are assumed to be a major source of contamination on exterior vessel and pipe surfaces as well as the interior surfaces of the Plutonium Loadout Hood. Therefore, the waste stream #1 sample with additional information obtained from waste stream #4 and #5. is considered adequate to provide an upper bound on the contamination inside the hood and on the process vessels/piping exterior.

3.2.4 Waste Stream #4 Sample – Pit/Sump Walls and Floor, Miscellaneous Sump Debris

One sample will be taken of the debris in the sump with a sampling tool, located in the pit portion of the Plutonium Loadout Hood. The sample will be taken vertically, so as to recover representative layers, if material happens to be stratified. The sample will be analyzed for radiological constituents and dangerous constituents, specifically metals and anions. In addition, the sample will be analyzed for organics and resins. Resin is attributed to 233-S operations, and the specific analyte list will need to be adjusted according to results of 233-S D&D activities. Physical properties (grain size, particle density, etc.) may be required.

The parameters of interest for this sample are primarily radiological and chemical in nature. The COCs for the pit/sump walls and floor and miscellaneous sump debris include the following:

TRU – concentration and isotopic distribution for Pu, Am, Np, and Cm (see Section 1.1.3)
Fission/Activation Products – Co-60, Cs-137, Sr-90 (GEA, Sr-90, gross alpha/beta)
Heavy Metals – chromium, cadmium, lead, nickel (ICP/TCLP methods); mercury (CVAA)
Organics – hexone, oxalic acid
Inorganics – nitric acid, sodium dichromate, sulfuric acid, ferrous sulfamate
Miscellaneous – Resins, paints, asbestos, PCBs, dangerous/waste by characteristics testing.

3.2.5 Waste Stream #5 – Potential Unknown Media in Process Vessels, Piping, and Plutonium Loadout Hood

One sample will be taken for each unknown encountered in the process vessels, piping, or Plutonium Loadout Hood. The material will be recovered by scraping or, in the case of a liquid, by recovery into a critically safe bottle. An unknown is defined as an unexpected material, but specific characteristics are difficult to identify. An unknown would include any liquid encountered in the vessels or piping, any regular (crystalline) form encountered, or any unusual-colored material found either in vessels/piping or in Plutonium Loadout Hood. Judgement of field personnel is required in these instances. The sample will be analyzed for radiological constituents and dangerous constituents. Dangerous constituents are those defined by characteristics testing.

The parameters of interest for this sample are primarily radiological and chemical in nature. The COCs for the potential unknown media in process vessels, piping, and plutonium loadout hood include the following:

TRU – concentration and isotopic distribution for Pu, Am, Np, and Cm (see Section. 1.1.3)
Fission/Activation Products – Co-60, Cs-137, Sr-90 (GEA, Sr-90, gross alpha/beta)
Dangerous Waste Characteristics Testing
Heavy Metals – chromium, cadmium, lead, nickel (ICP/TCLP methods); mercury (CVAA)
Organics – hexone, oxalic acid
Inorganics – nitric acid, sodium dichromate, sulfuric acid, ferrous sulfamate

3.2.6 Waste Stream #6 – Decontamination Wastes

One sample will be taken for each disposal container of segregated material collected from cleanup of floors, vessel walls, or hood surfaces. Damp cloth wipes are expected to be used in decontamination activities. One used wipe from initial decontamination activities that is representative, based on field screening, will be analyzed for radiological constituents and dangerous constituents, specifically metals and anions.

The parameters of interest for this sample are primarily radiological and chemical in nature. The COCs for the decontamination wastes include the following:

TRU – concentration and isotopic distribution for Pu, Am, Np, and Cm (see Section 1.1.3.).
Fission/Activation Products – Co-60, Cs-137, Sr-90 (GEA, Sr-90, gross alpha/beta)
Heavy Metals – chromium, cadmium, lead, nickel (ICP/TCLP methods); mercury (CVAA)
Organics – hexone, oxalic acid
Inorganics – nitric acid, sodium dichromate, sulfuric acid, ferrous sulfamate

3.2.7 General Comment

No field screening activities other than routine radiological surveys are planned at this time. Hand-held detectors will be used to control handling and shipping of sample bottles and general field activities. Field screening techniques may be implemented if shown to add value to the overall sampling and analysis program.

Because of the high levels of plutonium contamination expected in all samples, chemical extraction may be required. Field extraction techniques are possible but should be avoided unless absolutely necessary. Field extraction can result in undesirable cross-contamination effects. Laboratory extraction to separate out specific analytes is much more desirable. Field extractions may be required, particularly if the sample activity exceeds permissible limits for shipping and handling or if the presence of certain contaminants will hinder a laboratory's ability to test for other analytes. Specifically, plutonium extraction may be required and may be performed at the PFP analytical laboratory. Americium extraction may be required to remove background gamma so as to facilitate cesium-137 determinations.

3.2.8 Solid Waste Disposal

No sampling will be conducted for designating Solid Waste Streams. It is expected that all future waste streams will be dangerous, mixed, or radioactive (low-level or TRU).

- Procedure 3.1, "Sample Packaging and Shipping "
- Procedure 4.2, "Sample Storage and Shipping Facility"
- Procedure 3.0, "Chain of Custody," or, in accordance with BHI-SH-04, *Radiological Control Work Instructions* procedures:
- Procedure 6.3, "Radiological Material Shipment Surveys"
- Procedure 6.4, "Radiological Material Labeling and Packaging."

3.5 Management of Investigation Derived Waste

Investigation-derived waste (IDW) generated by characterization activities will be managed in accordance with BHI-EE-10, Waste Management Plan. Generated waste will be managed in accordance with the Site Specific Waste Management Instructions generated for the work package, rather than the IDW strategy document. Generated waste materials may be disposed of in ERDF as long as they meet the requirements of the BHI-00139, Environmental Restoration Disposal Facility Waste Acceptance Criteria. Although, it is expected that most waste will designate as TRU and will require shipment to the Central Waste Complex at the Hanford Site. The generated waste materials will be stored in an approved Radiation Management Area and will be disposed of at the end of work activities. Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract and agreements for return to the Hanford Site.

4.0 HEALTH AND SAFETY

This sampling program affords unique opportunities for contamination spread and personnel contamination and includes a limited potential for criticality. All field operations will be performed in accordance with BHI health and safety requirements outlined in BHI-SH-01, *Hanford ERC Environmental, Safety, and Health Program*, BHI-SH-04, *Radiological Control Work Instructions*, and the requirements of HSRCM-1, *Hanford Site Radiological Control Manual*. In addition, a work control package will be prepared in accordance with BHI-MA-02, *ERC Project Procedures*, which will further control site operations. This activity will also need to conform to specified engineering and administrative requirements as well as all applicable ALARA commitments, as specified in BHI-SH-01. This package will include an activity hazard analysis, site-specific health and safety plan, and applicable radiological work permits.

The sampling procedures and associated activities shall follow ALARA principles and will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team as required by BHI-QA-01, *ERC Quality Program*, and BHI-SH-01, *Hanford ERC Environmental, Safety, and Health Program*.

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BHI-EE-10, *Waste Management Plan*, Bechtel Hanford, Inc., Richland, Washington.

BHI-HR-02, *ERC Training Procedures*, Bechtel Hanford, Inc., Richland, Washington.

BHI-MA-02, *ERC Project Procedures*, Bechtel Hanford, Inc., Richland, Washington.

BHI-QA-01, *ERC Quality Program*, Bechtel Hanford, Inc., Richland, Washington.

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BHI-SH-04, *Radiological Control Work Instructions*, Bechtel Hanford, Inc., Richland, Washington.

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